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FERNALD SILO #4 REMOTE SURFACE MAPPING TECHNOLOGY SUPPORT DEMONSTRATION WORK PLAN MAY 1991

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ENCLOSURE

FERNALD SILO #4
REMOTE SURFACE MAPPING
TECHNOLOGY SUPPORT DEMONSTRATION
WORK PLAN

FEED MATERIALS PRODUCTION CENTER

MAY 1991

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Working under Contract #DE-AC05-86OR21600
To
The United States Department of Energy

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I. BACKGROUND/PURPOSE

There are four above ground concrete waste storage silos located at the Feed Materials Production Center (FMPC). The silos are 26' high and are cylindrical in shape, with an 80' diameter. The walls and the dome covers are constructed of reinforced concrete. The dome covers are self-supporting and cover the entire 80' diameter. Silos 1 and 2 (K-65 silos) were constructed in 1951 and 1952 for the purpose of storing K-65 residue material (pitchblende residue). Silo 3 contains "cold" metal oxide waste. And Silo 4 is empty and has never been used. Silos 3 and 4 are free standing structures, while Silos 1 and 2 are surrounded by an earthen berm for added support and radiation shielding.

The K-65 silos are currently releasing radon gas above NESHAP Subpart H limits, which represents a potential hazard to FMPC personnel and surrounding communities. This has caused heavy community and regulatory agency concern. A removal action (Silo 1 and 2 Removal Action) is planned to reduce the chronic radon emissions and control potential releases of residues from the K-65 silos (Silos 1 and 2). The removal action consists of applying a one foot thick layer of bentonite clay slurry on top of the silo contents. The bentonite application is an interim measure supporting future remedial actions. The removal action and future remediation actions are in support of CERCLA Operable Unit 4.

The schedule for submittal of the draft ROD (Record of Decision) on Operable Unit 4 is currently being negotiated. Construction on the chosen remedial alternative must begin within fifteen months after the final ROD is issued. In the interim, the Silo 1 and 2 Removal Action is planned. According to the consent agreement between the EPA and the DOE, the bentonite is scheduled to be in place by December 1, 1991.

The Silo 4 Remote Surface Mapping project is a Technology Support Demonstration (TSD) planned in support of FMPC CERCLA Operable Unit 4. The project is being performed as a joint effort by the FMPC, Oak Ridge National Laboratory (ORNL), and Sandia National Laboratory (SNL). The TSD project will demonstrate remote video, lighting, and surface mapping technology needed to support the removal and remedial action of Silos 1 and 2 at the FMPC. The demonstration will provide the information needed to guide the application of the mapping technology during the removal efforts. Since the waste surface in Silos 1 and 2 is irregular with both mounds and cracks, a contour mapping system is required to determine the initial state of the waste surface, and to verify and document sufficient bentonite coverage throughout the silos.

The surface mapping technology is being tested and demonstrated on the unused Silo 4 at the FMPC prior to its use in support of the Silo 1 and 2 Removal Action. The test of the mapping system will provide a field application to demonstrate equipment, procedures, and logistics to minimize contamination and hazardous exposures.

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II. HARDWARE/EQUIPMENT

The structured light source (25-30 mW Infrared Laser), alignment laser, low lux black and white video camera, lighting, and the pan/tilt positioner are mounted together to form an integrated assembly which will be mounted in the silo manway openings. The integrated assembly is referred to as a Measurement Unit (MU). Three MUs will be used during the Silo 4 demonstration.

1.0 STRUCTURED LIGHT SOURCE

1.1 Infrared laser (3)

A structured light source to define a 2-dimensional plane of light focused and scanned across a surface to measure 3-dimensional contour characteristics through orientation and range calibration.

1.2 Pan/tilt control (3)

A device to position the infrared laser and cameras remotely inside the storage silo with two axes of freedom.

1.3 Positioning encoders

A pan-tilt position feedback sensor which electronically tells the controller exact positioning with accuracies of $\pm$0.035 degrees.

1.4 Mounting hardware

Hardware needed for mounting the pan-tilt assembly to the infrared laser.

2.0 CAMERA SYSTEMS

2.1 Monitor

Another name for a television which provides visual feedback to the operator for oversight of control inputs to the output device.

2.2 Low lux black and white video cameras (3)

Receivers of the infrared laser light source reflected from the surface being measured.

2.3 Mounting hardware

Hardware necessary to interface mapping equipment being deployed through the silo manways.

3.0 CONTROL HARDWARE

3.1 Sparc 2 SUN work station

A Unix based controller with an alpha numeric keyboard and VGA monitor utilizing PV wave and VX works software (C^{++}language).

3.2 DataCube Digimax Board

An input/output printed circuit board mounted in the VME rack which digitizes the video frame information coming from the FrameStore board.

3.3 DataCube FrameStore Board

An input/output printed circuit board which puts to memory the information the video camera is seeing in real time.

3.4 DataCube Cable

Cabling interface from the Digimax and FrameStore boards to the controller.

3.5 VME Rack

A cabinet to house all input/output boards in a proper array.

3.6 Cooling fan assembly

To be mounted to the environmental enclosure to allow proper cooling of internally mounted computer hardware.

III. PREPARATION/SET-UP

1.0 DESIGN CONSIDERATIONS/REQUIREMENTS

1.1 STRUCTURAL REQUIREMENTS

Due to the limited structural integrity of the silo domes, certain restrictions have been imposed on all work/construction taking place on or in Silo 4.

* No more than three people will be permitted on the dome at one time.
* Personnel will be permitted to walk on the dome to reach side manways. However, all personnel will be tied-off to the dome railing or to a remote crane.
* All equipment/personnel on the silo's dome will not exceed a 700 pound (total) live vertical point load limit.
* Only the east ladder will be used to access Silo 4.

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For the surface mapping in Silos 1 and 2, stairs will be fabricated for access to the center manway. Fabrication of stairs will be performed as part of the Silo 1 and 2 Removal Action.

1.2 UTILITY REQUIREMENTS

ORNL and SNL will provide a list of requirements to WMCO for power and other utilities. These requirements will be incorporated in the utility specification for the work station.

1.3 FIRE AND SAFETY PROTECTION

The work station structure conforms to all safety requirements as listed in procedures IH&S-F-06, "Sitting and Use of Office Trailers and Other Portable Structures at FMPC", and DOE EV-0043.

All designs associated with the demonstration project will be reviewed by FMPC IRS&T prior to installation. FMPC Fire and Safety will participate in a final Operational Readiness Review walkthrough of the demonstration system and all noted deficiencies will be corrected prior to system operation.

1.4 DESIGN REVIEW AND APPROVAL

All designs prepared in support of this project will be reviewed as a minimum by IRS&T (WMCO), QA (WMCO), Rust Engineering, and approved by the project engineer, the Operable Unit 4 Manager, and DOE-FMPC.

2.0 CONSTRUCTION

2.1 DESIGN

Designs in support of the demonstration project include:

- The flange interface for the silo manways (part of the Radon Treatment System, RTS, Upgrade Project)
- The mounting assembly to the flange interface
- Control hardware logic flow chart
- Design of a weather shelter box for out-of-silo hardware
- Utilities
- Work Station

2.2 DAVIS-BACON DETERMINATION

This project was determined to be professional services only by the Davis-Bacon determination.

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2.3 INSTALLATION/WORK ORDERS

ORNL and SNL personnel will perform the initial installation of the MUs during the Silo 4 demonstration. In addition, ORNL and SNL personnel will provide sub-contractor personnel with hands-on training on equipment installation. Rust Engineering and/or equivalent subcontractor (International Technology Corp.) will be responsible for installation of the MUs and control system during the Silo 1 and 2 Removal Action. Rust will also perform all other construction activities in support of this project. IT will provide support as required due to prior experience working on the silos. ORNL and SNL are contracted as technical support and for impromptu equipment maintenance.

3.0 FINAL INSPECTION

As a minimum, a level 3 Operational Readiness Review (ORR) has been proposed and will be performed on the mapping system project. A final ORR walkthrough inspection and approval of the completed system will be performed by WMCO management, QA, IRS&T (Fire and Safety), Rust Engineering, and Operable Unit 4 personnel. In addition, approval from the ORR Board will be obtained prior to the operation of the system. All significant deficiencies noted during the walkthrough will be corrected prior to the operation of the system.

4.0 DISMANTLING, MOVING, OR REMOVAL OF EQUIPMENT

Mapping in Silo 4 will be conducted from each of the four side manways and the center manway. As mapping is completed in each location, the MUs will be moved to other manway locations for subsequent mapping operations. The control work station will remain in place throughout the mapping operations on Silos 4, 1, and 2. Specific details on the method of installation and removal of equipment is covered in Section V, part 2.1.

After the demonstration mapping is complete, the structured light source/video camera assemblies will be removed from Silo 4 and stored in the work station. During the removal action, the equipment will be installed in the manway openings on Silo 1 or 2. A bag-in/bag-out containment system will be employed during some of the equipment installations in Silo 4 for demonstration and training purposes. The bag-in/bag-out containment system will be used for all equipment installations during the Silos 1 and 2 Removal Action to prevent radon exposures and releases. After the mapping in Silos 1 and 2 is completed, the MUs will be removed and decontaminated. (Specific decontamination methods are covered in Section III, part 5.0.) The work station will remain in the area unless otherwise specified by the O.U. Manager.

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5.0 DECONTAMINATION

All equipment used inside the silos was specified and designed to allow minimal decontamination efforts. Upon removal from the silos and prior to removal from the K-65 area, the equipment will be monitored by Radiation Safety technicians to ensure contamination levels are <3000 dpm/100 cm^2 total fixed plus removable alpha, <5000 dpm/100 cm^2 total fixed plus removable beta/gamma, <20 dpm/100 cm^2 removable alpha, and <1000 dpm/100 cm^2 removable beta/gamma. The Radiation Safety technicians will attempt to decontaminate any contaminated equipment in the K-65 area. If the decontamination is unsuccessful, the equipment will be bagged, transported to the Decontamination and Decommissioning (D&D) facility, and hand washed with soap and water. Minimal decontamination is expected since the in-silo equipment will remain in the dome headspace and the out-of-silo equipment is at low risk of coming in contact with radioactive particulates.

All personnel will be monitored by Radiation Safety technicians prior to exiting the K-65 compound area. If personnel contamination is discovered the following will occur:

- The affected area will be covered.
- Radiological Safety and the AEDO will be notified.
- The individual will be transported to Medical.
- Radiation Safety shall decontaminate the affected areas in accordance with SPP-35-017, "Personnel Decontamination".

Additional decontamination requirements can be found in the Health and Safety Plan for this project (Attachment 1).

6.0 PROCEDURES AND PROCEDURE DEVELOPMENT

The Silo 4 surface mapping demonstration will be performed based on the procedure in this work plan (see Section V, part 2.0). Aspects of this procedure will be developed and modified as the field demonstration is performed and the operating methods are perfected.

IV. TRAINING REQUIREMENTS

1.0 WORKER TRAINING

Personnel from WMCO, ORNL, SNL, RUST and IT working in the Silo 4 area and designated as workers will be trained as Occasional Hazardous Site Workers [Reference: 29 CFR 1910.120 (e)(3)(ii)]. The following training constitutes compliance requirements:

* OSHA/RCRA 1910.120 or equivalent (24-hour training must conform to the requirements of the Occupational Safety and Health Administration (OSHA) standards identified in 29 CFR 1910.120)
* General Safety
* Nuclear Criticality or equivalent
* OSHA & You
* Portable Fire Extinguisher
* Radiation Safety

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* Radiation Safety Personal Monitoring
* 8-hour field experience at the FMPC
* Energy Control Awareness Training
* K-65 Area Specific Training (including but not limited to WMCO Standard Operating Procedure (SOP) 65-C-201, "K-65 Silo Numbers 1 and 2 Area Emergencies", dated 9/10/1990 or latest version)
* K-65 Operational Safety Requirements
* Surface mapping procedures in this work plan
* Project Specific Health and Safety Plan

NOTE: Proof of respirator training and fit-testing, and recent medical examination are also required.

All personnel will be trained at WMCO, ORNL, or SNL. If the training is conducted at ORNL or SNL, copies of the training abstracts or training lesson plans, and personnel training records or training certificates will be submitted to WMCO Centralized Training to verify the training and documentation conforms to the requirements of the FMPC.

2.0 VISITOR TRAINING

Visitors will be escorted at all times in controlled areas. In addition, visitors are required to complete the following training:

* Visitor orientation videotape
* Briefing on the Project Specific Health and Safety Plan

V. DEMONSTRATION

1.0 SYSTEM OPERABILITY TESTING

Standing water in Silo 4 will be pumped out by the FMPC Utility department prior to operability testing.

The project will be checked for proper installation and equipment function prior to cold test operation. Checks will include but not be limited to: cable hook-ups, software/hardware integration, data acquisition, calibration/alignment, synchronization, control system diagnostics, and software data averaging algorithms. A checklist will be developed as part of the ORR and used for this phase.

2.0 COLD TEST

Initial testing (cold test) of the mapping system will be performed on FMPC Silo 4 prior to its use in support of the removal action. Silo 4 is empty and is identical in construction to Silos 1 and 2 where the removal action (bentonite slurry addition) will be performed. Each silo contains five 20 inch diameter manways, one in the center of the dome and four spaced approximately evenly around the side of the dome. During this test, the four side manways will be labeled as North, South, East, and West for the purposes of unique identification.

2.1 TEST PROCEDURE

Two separate equipment configurations are planned for the cold test:

The first configuration will occupy three outer manways at one time. Each manway will consist of a MU suspended from a manway interface cover. The MU assembly will be comprised of a laser structured light source/alignment laser/video camera/lighting sub-assembly mounted to a 2-axis pan/tilt positioner. This combination of equipment permits each MU to play the role of either a laser emitter or a detector of the structured light. This robust system array will provide greater accuracy, higher efficiency, reduce exposure time, and limit risk of equipment misalignment and damage due to repetitive handling from manway to manway. Once the initial equipment array has gathered as much data as possible, a different series of three manways will be necessary to capture the remaining surface area for a complete 3-dimensional contour of approximately 5000 square feet (see Figure 1).

The second configuration will also occupy three manways (the center manway and two outer manways). The two outer manways being utilized will be 180 degrees apart so the system deployed through the center manway can operate along a single path with limited mechanical interruption during its scan of the surface. The same two outer manway equipment systems will then be rotated 90 degrees while still retaining a 180 degree configuration. Another scan will be done to complete the 3-dimensional contour map (see Figure 3).

Due to the extremely small angles in which the MUs must operate in the K-65 Silos(worst case approximately 14 degrees), several surface scans must be produced to gather sufficient information in determining the abnormal contour of the waste surface. Residue mounds in the K-65 silos in excess of 6 feet high causes shadowing of data from various angles forcing different equipment deployment arrays and utilizing all available manways to gather all information necessary for a model of the silo's interior.

The MUs will be mounted on flange assemblies designed to be mounted and clamped on the new manway interface. When installed, the equipment will be suspended from the flange assemblies inside the silo. A bag-in/bag-out containment system will be demonstrated on a portion of the equipment installation on Silo 4 to ensure personnel are able to use the containment system properly. The test coordinator will determine the extent the bag-in/bag-out system is used during the Silo 4 demonstration. The bag-in/bag-out containment system will be used around the manway openings during all equipment installations in Silos 1 and 2 to provide protection from radon exposure.

For the Silo 4 demonstration, all equipment will be hand carried to the silo dome using only the east staircase. When the MUs are mounted in the manways, the equipment assemblies will be hand carried along the dome to the manway openings. After personnel unbolt and remove the manway covers, the MUs will be lowered through the manway openings and clamped onto the existing manway flanges. The manway covers will be set off to the side on the dome surface. If the bag-in/bag-out containment system is used, the manway covers will remain in the bag.

If the MU is mounted in the center manway during the Silo 1 and 2 Removal Action, the assembly will be placed on a man-basket and lifted by a crane above the manway. (The crane will be inspected and operated in accordance with FMPC Standard Operating Procedures.) Personnel will climb the dome by means of fabricated stairs to access the man-basket. A trap door in the man-basket will be opened and the center manway interface cover will be unbolted and removed. The structured light source/video camera assembly will then be lowered through the trap door and clamped onto the existing manway flange. The manway cover will be set off to the side.

When the equipment is installed, the exact location/placement of all equipment will be marked (color coded, etc.) so the equipment can be repositioned for subsequent mapping operations. The best method for marking equipment position will be developed/determined during the demonstration test. Exact repositioning of the equipment will be required for valid data and correlation comparisons before and after the bentonite removal action. To assist equipment repositioning, a fixed target (Global Reference Frame, GRF) will be lowered into the silo through one of the sounding ports. This suspended target will give a permanent marker to align and calibrate the equipment when reinstalling and for performing routine calibration checks during mapping operations (see Section 2.2). The mapping tests on Silo #4 will be performed a minimum of twice to test our ability to reposition the equipment accurately. An indication of the accuracy of the equipment repositioning can be made by checking the precision of the mapping data from each test run. In addition, an easily removable material (ex. bucket with retrieval cable attached) will be lowered onto the silo floor between mapping operations to test the mapping system's ability to discern differences in surface contour.

In addition to marking the exact equipment location, the particular structured light source/video camera assembly used at each manway will be documented. This will be done so subsequent mapping operations will be performed with the same MU in the same location. This will eliminate any data variations due to equipment differences. If time permits, another map will be generated after moving the equipment to different manways to determine what data variations can be expected due to equipment variations.

Once installed, the structured light source/video camera assembly will be aimed at various points (using an incremental sweeping motion) within the silo to map predetermined sections of the interior surface. At each incremental location the structured light source will reflect a plane of laser light off the interior surfaces of the silos and residues. The video cameras will receive the reflected laser signals and transmit the data to the remote work station. An equipment calibration/alignment check will be performed before and after each section is mapped. The section will be remapped if the check indicates the equipment is out of calibration/alignment by ±2 inches. All data will be analyzed and all operations are controlled from the work station. Robotics technology is being used to control the movement of the structured light source and the video cameras. Computer software will control the robotics to synchronize the positioning of the structured light source and the video cameras used to receive the signal. The video cameras can also be used to provide visual verification during the cold test.

2.2 EQUIPMENT CALIBRATION

In order to calibrate/align the equipment assembly, a global reference frame (GRF) will be placed in the silo. This device provides the reference for all mapping data and is composed of four photo detectors on a precision mount (see Figure 4). Its location is not critical, but it must be visible from each of the MUs and must remain in the silo in a stable location throughout all the mapping operations. For this TSD, the GRF was designed to permit mounting near the roof of the silo in one of the two inch sounding ports.

An automated calibration procedure will be initiated that uses the alignment lasers to locate each MU with respect to the GRF. The calibration procedure will determine both the position and orientation of the MUs with respect to the GRF.

During the initial test of the remote surface mapping equipment on Silo 4, the MUs will be frequently recalibrated using the automated procedure. This will permit the effects of changes in dome shape resulting from changes in barometric pressure, temperature, etc. to be characterized. In addition, when the MUs are moved and reinstalled in the manway openings, the automated calibration procedure will be used to establish the new positions of the MUs. After calibration is completed, mapping can be resumed.

2.3 DATA GATHERING

The structured light source will initially be pointed downward in the silo. Through the use of remote pan and tilt controls, the light source will be pointed to follow a predetermined straight line path in a constant incremental sweeping motion. The video camera installed to receive the reflected laser signal has been synchronized with the motion of the structured light source.

The surface mapping equipment has been designed to produce a minimum of one data point for every square foot of surface area in the silo. This ensures a minimum of 5026 data points for each silo. However, since there will be areas of overlap from each scan, more than 5026 data points will be taken. Where more than one data point is taken in a given area, the data will be correlated and averaged.

One objective of the testing is to determine the optimum number of scans necessary to map the silo interior surface. For the first configuration there will be a minimum of ten scans per silo or a minimum of two scans from each of the structured light source locations (see below and Figure 1). Since the structured light source lens has an angle of view of approximately 20 degrees, the actual number of scans necessary to map the entire interior surface will be greater than ten (see Figure 2). However, the number of scans needed to map the silo can not be accurately determined in advance and will therefore be determined as part of the testing. The following is an example of one of the possible equipment configurations which could be used utilizing three outer manway openings:

Structured Light Source Transmits From	To Receiving Video Camera Location
North manway	to the south camera & the west camera
South manway	to the north camera & the west camera
West manway	to the north camera & the south camera
(After moving one structured light source/camera assembly from the west manway to the east manway, the mapping will continue.)	
East manway	to the north camera & the south camera
North manway	to the east camera
South manway	to the east camera

Since there are many similar equipment configurations which can utilize three manway openings and produce equal results, the test coordinator will make the final determination of equipment locations.

For the second configuration there will be a minimum of four scans for every contour map generated (see below and Figure 3). As with the first configuration, the optimum number of scans necessary to map the silo interior will be determined during the test.

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Structured Light Source Transmits From	To Receiving Video Camera Location
Center manway	to the north camera & the south camera
(After moving two structured light source/camera assemblies from the north and south manways to the east and west manway, the mapping will continue.)	
Center manway	to the east camera & the west camera

Another objective of the test is to determine the operating limits of the surface mapping equipment. In order to accomplish this, multiple scans will be made from each location to determine the extent of mapping coverage possible from each location.

In addition to mapping data, selected meteorological and calibration data will be collected. This will permit the effects of changes in dome shape resulting from changes in barometric pressure, temperature, etc. to be characterized.

2.4 DATA ANALYSIS

All data generated by the surface mapping equipment is automatically transmitted to the work station. The data is analyzed automatically to produce a 3-D contour map diagram of the interior silo surface (Figure 5) and a tabular printout of the data. The system is also capable of comparing data and contour maps from various mapping operations.

As a minimum, the following data analyses will be performed:

* Comparison of data between equipment configuration 1 vs. equipment configuration 2. Data generated from the two equipment configurations will be compared as a means of testing/demonstrating the reproducibility of the surface mapping results.

* Comparison of data between initial mapping and maps generated after the MUs are removed from the manway openings and reinstalled in their original locations. This will test our ability to accurately reposition the equipment.

* Comparison of data between initial mapping and maps generated after the MUs are removed from the manway openings and reinstalled in different locations. This will determine what data variations can be expected due to equipment variations.

* Comparison of data between initial mapping and maps generated after the addition of an easily removable filler material. This will test the mapping system's ability to discern differences in surface contour.

In addition to mapping data, selected meteorological and calibration data will be collected. This will permit the effects of changes in dome shape resulting from changes in barometric pressure, temperature, etc. to be characterized.

As the demonstration test progresses, additional analyses may be identified.

3.0 REMOVAL ACTION SUPPORT

After demonstrating the remote video, lighting, and surface mapping technology and procedures in Silo 4, the technology will be applied to the removal actions in Silos 1 and 2 scheduled under Operable Unit 4. The equipment configuration providing the best test results during the cold demonstration test will be proposed for use during the removal action (bentonite application). The mapping and removal action will be completed on one silo before proceeding to the second silo. Personnel from ORNL and SNL will continue to provide assistance during the removal action mapping application.

3.1 BASELINE MAPPING

The surface mapping system will be used to map the surfaces inside the silos prior to the bentonite application. This will provide a baseline surface map for data comparisons after the bentonite application.

3.2 MAPPING DURING BENTONITE APPLICATION

The bentonite clay slurry will be applied inside the silos to a minimum laminated thickness of one foot and will be applied as specified in "Silos 1 and 2 (K-65) Removal Action Work Plan" dated November, 1990.

In-process mapping may be necessary prior to the final map to identify low points (bentonite thickness of less than 12 inches). In-process mapping will be done at the discretion of the project manager. The MUs will be removed during the removal action and reinstalled in the silo whenever mapping is deemed necessary.

3.3 FINAL MAPPING

After the bentonite application is complete, the mapping system will produce a final surface map.

After the bentonite has been applied in the last silo and the minimum bentonite thickness has been verified, the surface mapping equipment will be removed from the silo and decontaminated.

3.4 DATA ANALYSIS

The surface mapping data generated prior to the bentonite application will be compared to the surface mapping data generated during and after the bentonite application to verify a minimum one foot thick bentonite layer was deposited in the silos. The computer analysis will perform this function automatically using software algorithms.

VI. SUCCESS CRITERIA

1.0 TECHNICAL OBJECTIVES

* The surface mapping system must have the ability to differentiate the surface level inside the silos within ±2.0 inches.

  The structured light source and video receiving cameras will be calibrated in a laboratory setting at ORNL. By reflecting the laser off a fixed target (GRF), and measuring the exact distances between the light source, target, and receiving camera, the equipment can be precisely calibrated. The objective will be verified as successful if the equipment can measure known distances after the initial calibration to within ±2 inches. Any errors in accuracy will be documented and taken into account in future data analyses.

* The surface mapping system must have repeatability of results with a physical baseline for comparison.

  When the mapping equipment is installed for the Silo 4 demonstration, the equipment will be calibrated based on the calibration results obtained at ORNL and by using a fixed target (GRF) suspended in the silo. In addition, the calibration of the equipment will be periodically checked and adjusted during the mapping operation using the fixed target. The silo will then be mapped at least twice. The contour maps generated will be automatically compared by the computer software to test the repeatability (precision) of the results. The objective will be verified as successful if the results are repeated within ±1/2 inch.

* The surface mapping system must provide accurate camera positioning, recording clarity, and range measurements needed for a safe operation during the test.

  This will be a subjective judgement on the part of the personnel operating the equipment.

* The surface mapping system must perform to its designed capabilities without being distorted by radiation hardening.

  The equipment specifications were written to include materials of construction which would be resistant to radiation hardening and can not be tested effectively in Silo 4.

2.0 PROGRAMMATIC OBJECTIVES

* Involve regulatory bodies to ensure process demonstration can be technically acceptable in support of the scheduled removal action.

  Verbal EPA approval was obtained for the Silo 4 surface mapping demonstration.

* Field-demonstrate the test equipment to satisfy the Operable Unit 4 Project needs for their removal/remedial actions.

  The objective will be met by the performance of the Silo 4 demonstration.

* Conduct the program to ensure successful application at other facilities.

  The equipment was designed based on a worst case scenario.

* Demonstrate/provide technology integration.

  Section X provides details on how this objective will be accomplished.

VII. SAFETY REQUIREMENTS

Safety restrictions for access to the Silo 4 dome include:

* Use east ladder only.
* Personnel must be fully dressed in company issued clothing.
* Live vertical point load limit of 700 pounds.
* Do not access if the dome's surface is wet or slippery.
* Do not wear shoe coverings.
* Contact Radiological Safety prior to access.

While working on the silo and accessing the side manways, personnel are required to be tied-off to the silo railings. When working within a ten foot radius of the center manway, personnel are required to be tied-off to a remotely positioned crane. Additional safety equipment and safety requirements are identified in the approved OSHA Health and Safety Plan for this project (attached).

Radon protection during the mapping of Silos 1 and 2 is covered under "Silos 1 and 2 (K-65 Silos) Removal Action Work Plan", dated November, 1990.

VIII. QUALITY ASSURANCE

A Quality Assurance (QA) Level of 3 has been assigned to this project based on the criteria as listed in FMPC Site Procedure FMPC-711, "Quality Levels". Subsequently, a project specific QA Plan is not required for the demonstration.

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The Remote Surface Mapping demonstration will be conducted according to the requirements of the overall quality assurance program at the FMPC which is described in the Site Quality Assurance Plan, FMPC 2139. The Site Quality Assurance Plan is based on the criteria specified in ASME NQA-1, Federal EPA Guideline QAMS-005/80, and DOE Orders 5700.6 and 5400.1. Specific quality assurance requirements will be incorporated into written and approved procedures, and into personnel training. Periodic surveillances will be completed to verify compliance with established procedures.

IX. DOCUMENT/REGULATORY REQUIREMENTS

1.0 HEALTH AND SAFETY PLAN

The work performed will be consistent with the Health and Safety Plan prepared for this demonstration. A copy of this plan is attached (Attachment 1) as part of this work plan. The plan identifies, evaluates, and controls all safety and health hazards. In addition, it provides for emergency response for hazardous operations. The plan is consistent with 29 CFR 1910.120 and the FMPC Site Health and Safety Plan. Safety documentation will be prepared according to FMPC-2116 Topical Manual, "Implementing FMPC Policies and Procedures for System Safety Analysis and Review System", and DOE/OR-901, "Guidance for Preparation of Safety Analysis Reports".

2.0 SAFETY ASSESSMENT

A Safety Assessment (SA) is a brief, factual, and objective document which determines if activities involve hazards other than those standard to industry that require elimination, control, or mitigation, thereby establishing the need for a Safety Analysis report. An SA is required of all operations or modifications to operations per DOE Order 5481.1B.

An SA (91-1007, Attachment 2) has been prepared for the Silo 4 demonstration according to FMPC-2116 Topical Manual, "Implementing FMPC Policies and Procedures for System Safety Analysis and Review System" and FMPC Standard Operating Procedure (SOP) SP-A-01-103. Nuclear and System Safety has determined no additional safety analysis documentation is required.

3.0 RISK ASSESSMENT

A Risk Assessment identifies the potential process hazards and probabilities of occurring by using Failure Mode and Effects Analysis concepts. A Risk Assessment has been prepared for this project according to FMPC 712, "Vulnerability and Risk Assessment and Management". Based on the results of the Risk Assessment, a Risk Management Plan is not required.

4.0 NEPA DOCUMENTATION

A CATEX (Categorical Exclusion) was submitted on January 17, 1991, for NEPA compliance related to the bentonite removal action. No further NEPA documentation is required for this project activity (Attachment 3).

X. TECHNOLOGY INTEGRATION

Technology Support Demonstrations (TSD) are a means to develop and prove new technology to support environmental removal and remedial actions within the DOE complex. An important outgrowth of these demonstrations is the need to disseminate information and diffuse technology to those facilities within the DOE complex and private industry which could benefit from the technical knowledge and experience gained from these demonstrations. The following are planned methods of achieving these objectives:

* Host a public and regulatory demonstration of the technology
* Presentation of a paper at the Environmental Remediation Symposium (scheduled for 9/91)
* Office of Technical Development (OTD) Monthly Activities
  - Office of Technical Development/Technical Program Manager (OTD/TPM) meetings
  - Office of Technical Development/Integrated Demonstration Coordinator (OTD/IDC) meetings
  - Robotic Technology Development Program (RTDP) meetings
* Summary of results and analysis of the demonstration to be published as an National Technical Information Service (NTIS) document
* Commercial technology licensing
* Preparation of a project video on the technology for OTD distribution
* Submit data and results of the demonstration to the Superfund Innovative Technology Evaluation Program for further evaluation and be included in their technology reference guide document for national distribution
* Submit project information to the EPA technology database such as ATTIC (Alternative Treatment Technology Information Center)

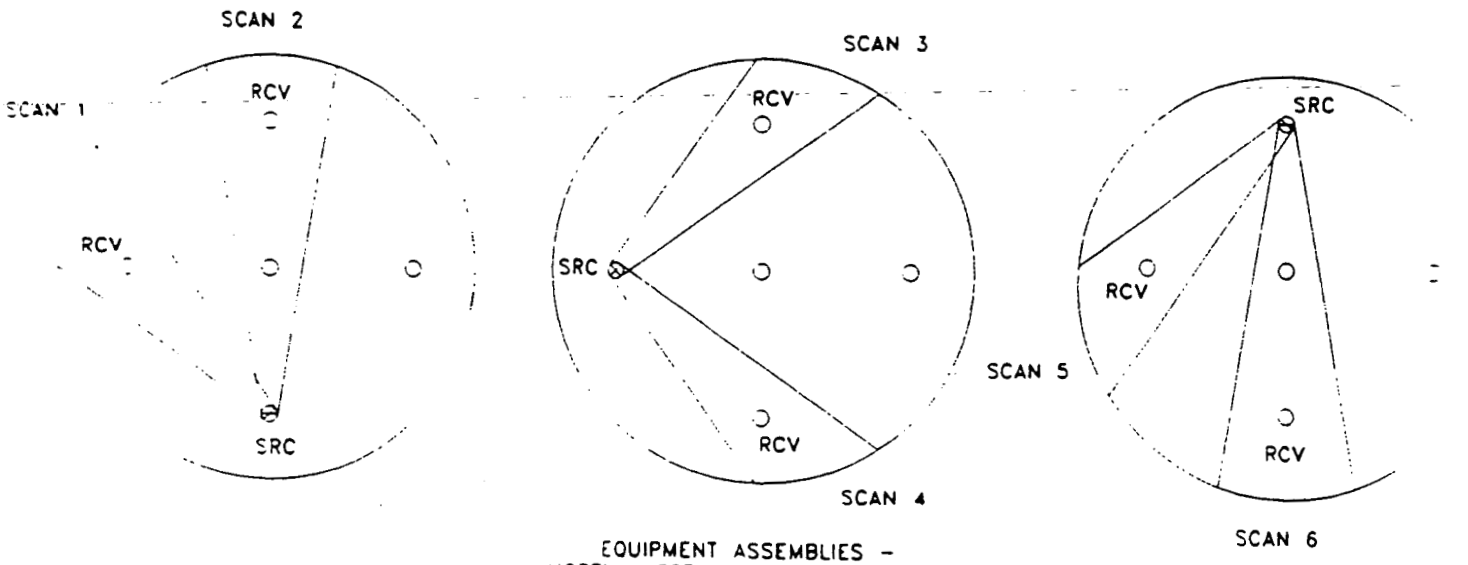
This demonstration will also demonstrate the results of active technology infusion. Technologies have been assembled from two DOE national labs, utilizing several state-of-the-art commercial systems which have been integrated into one system.

XI. EVALUATION/SUMMARY REPORT

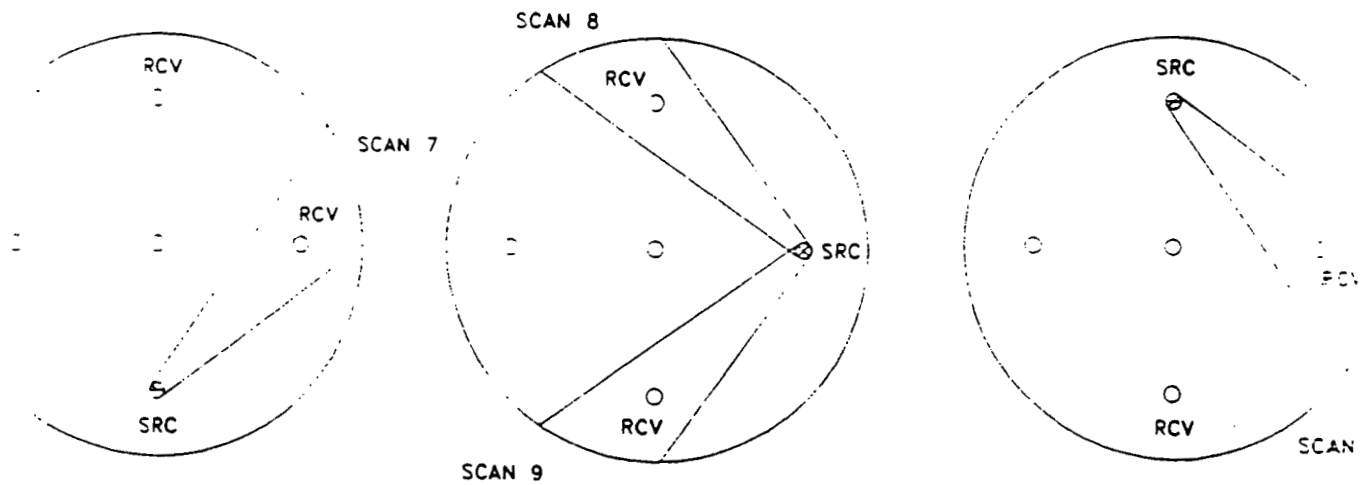
An evaluation/summary report detailing the test results will be written following the completion of the demonstration test.

STRUCTURED LIGHT COVERAGE
SIDE MANWAYS

MINIMUM SCANS



EQUIPMENT ASSEMBLIES –
NORTH, WEST, AND SOUTH MANWAYS



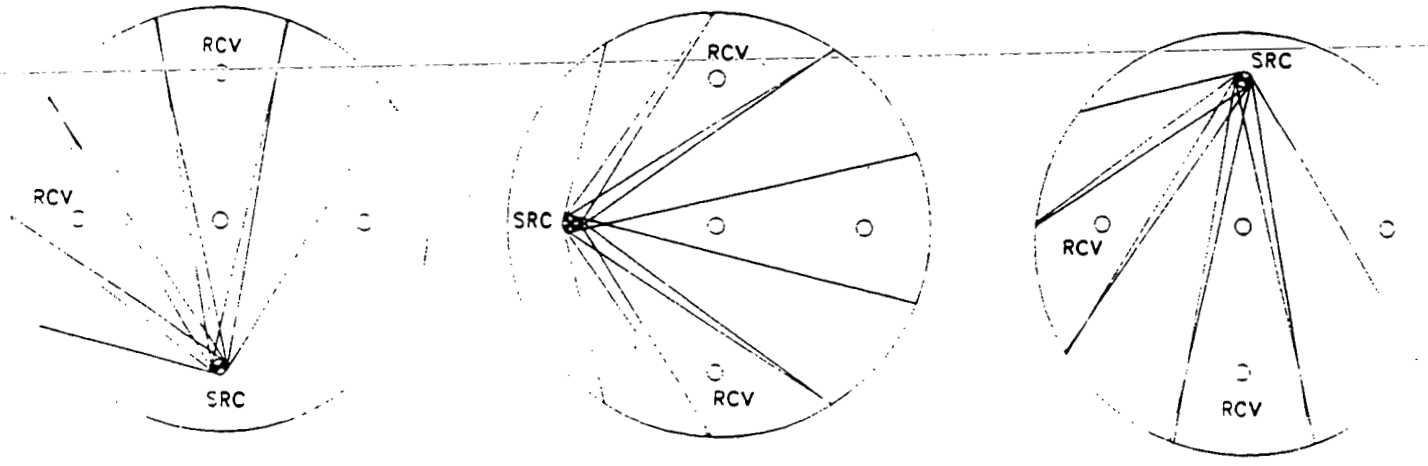
EQUIPMENT ASSEMBLIES –
NORTH, EAST, AND SOUTH MANWAYS

SRC – EQUIPMENT ASSEMBLY SENDING LASER SIGNAL
RCV – EQUIPMENT ASSEMBLY RECEIVING LASER SIGNAL

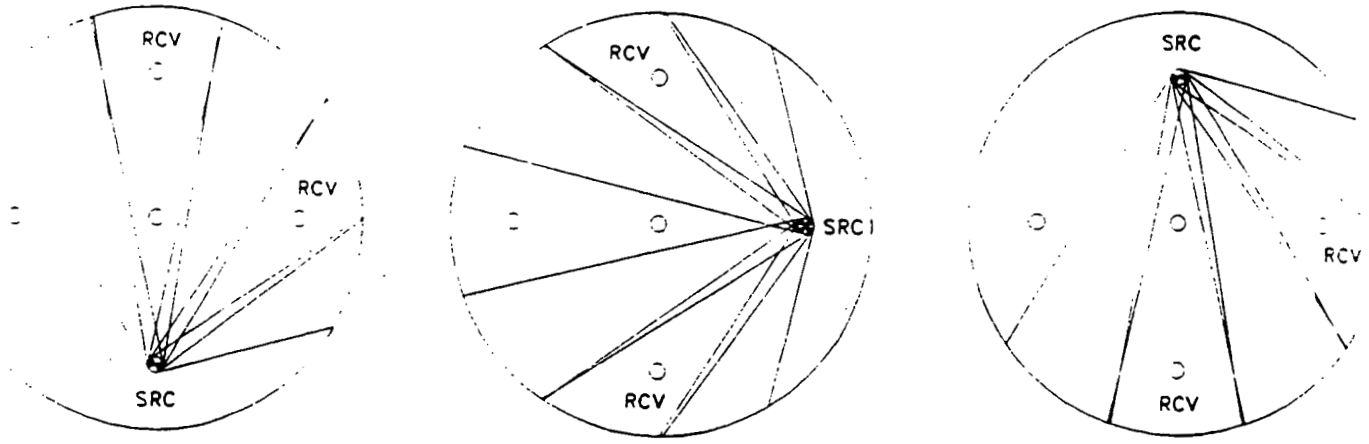
Figure 1

STRUCTURED LIGHT COVERAGE 1562
SIDE MANWAYS

MULTIPLE SCANS



EQUIPMENT ASSEMBLIES -
NORTH, WEST, AND SOUTH MANWAYS



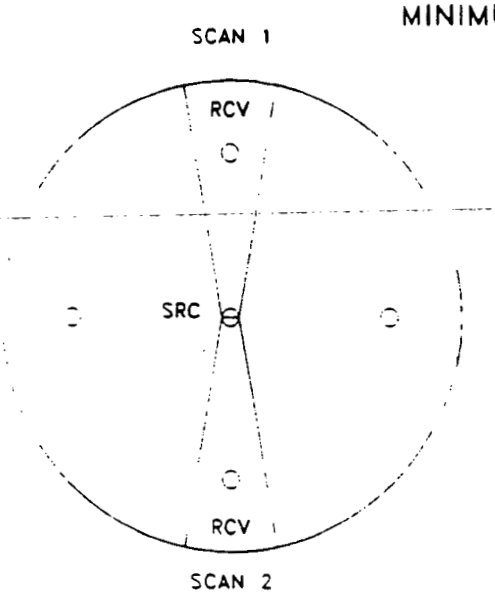
EQUIPMENT ASSEMBLIES -
NORTH, EAST, AND SOUTH MANWAYS

SRC - EQUIPMENT ASSEMBLY SENDING LASER SIGNAL
RCV - EQUIPMENT ASSEMBLY RECEIVING LASER SIGNAL

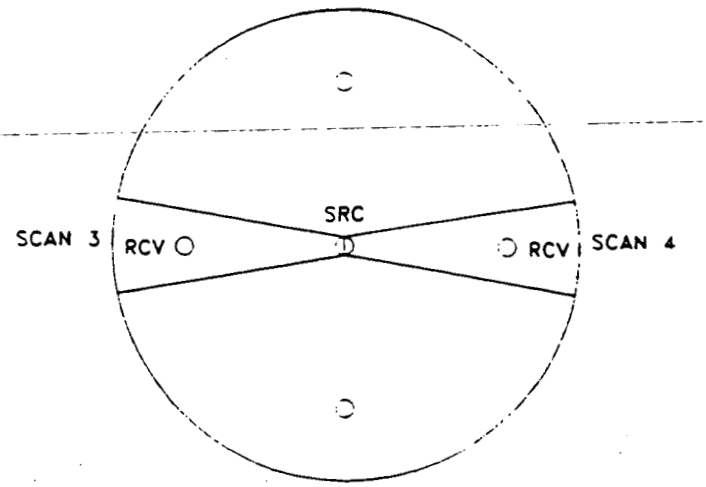
Figure 2

STRUCTURED LIGHT COVERAGE 1562
CENTER MANWAY

MINIMUM SCANS

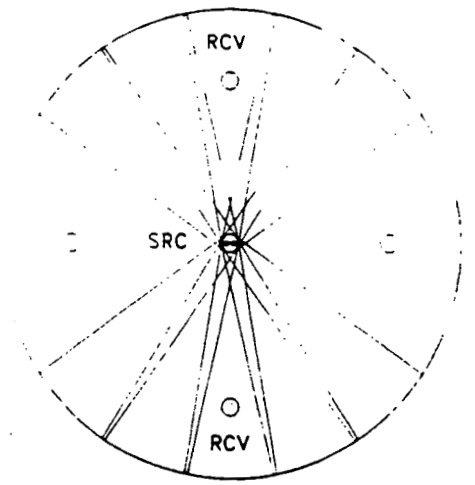


EQUIPMENT ASSEMBLIES –
NORTH, SOUTH, AND CENTER MANWAYS

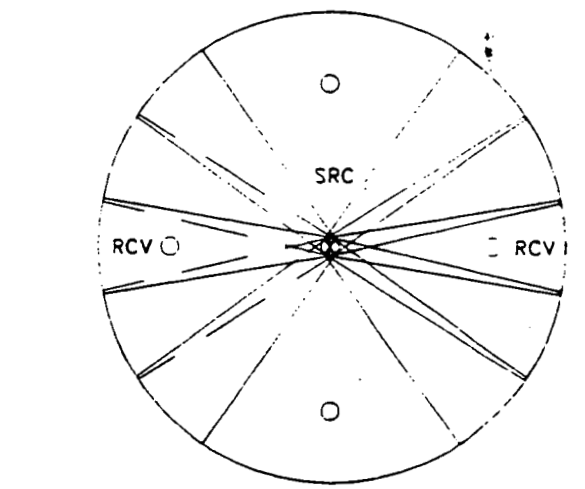


EQUIPMENT ASSEMBLIES –
EAST, WEST, AND CENTER MANWAYS

MULTIPLE SCANS



EQUIPMENT ASSEMBLIES –
NORTH, SOUTH, AND CENTER MANWAYS

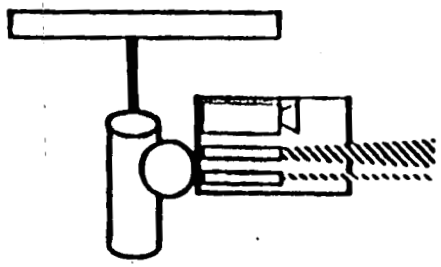


EQUIPMENT ASSEMBLIES –
EAST, WEST, AND CENTER MANWAYS

SRC – EQUIPMENT ASSEMBLY SENDING LASER SIGNAL
RCV – EQUIPMENT ASSEMBLY RECEIVING LASER SIGNAL

Figure 3

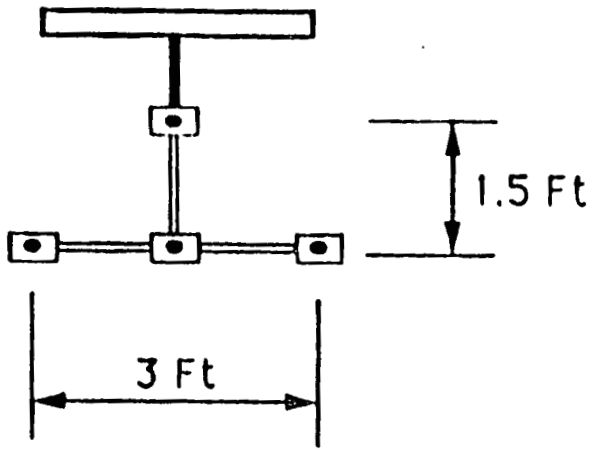
ER&WM - Fernald
Mapping Equipment



Measurement Unit (MU)

Combines a
Structured Light Source,
Camera Unit, and
an Alignment Laser all on a
Pan+Tilt Unit.

(3) MUs Total.



Global Reference Frame (GRF)

Uses four photocells on a
precision mount.

(1) GRF Total.

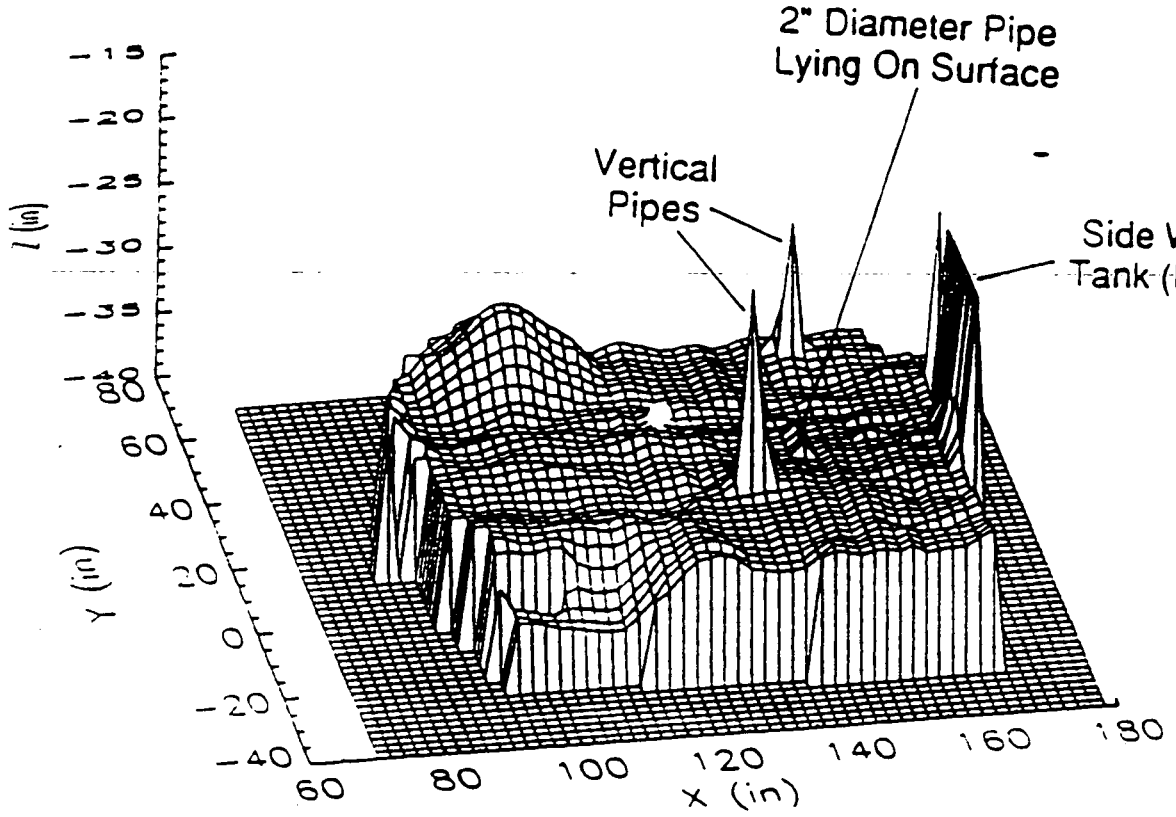

2" Diameter Pipe
Lying On Surface
Vertical
Pipes
Side Wall o
Tank (Partia
Z (in)
-15
-20
-25
-30
-35
-40
Y (in)
80
60
40
20
0
-20
-40
60
80
100
120
140
160
180
X (in)

Figure 5

HEALTH AND SAFETY PLAN

FOR THE

SILO #4

INTEGRATED TECHNOLOGY DEMONSTRATION

FEED MATERIALS PRODUCTION CENTER

FERNALD, OHIO

MARCH, 1991

REVIEW:

Paul J. Polus — 5-20-91

CENTRALIZED TRAINING
WESTINGHOUSE MATERIALS COMPANY OF OHIO — DATE

[signature] — 5/21/91

RADIOLOGICAL SAFETY
WESTINGHOUSE MATERIALS COMPANY OF OHIO — DATE

[signature] — 5-20-91

INDUSTRIAL HYGIENE AND SAFETY
WESTINGHOUSE MATERIALS COMPANY OF OHIO — DATE

NOTE: This plan and associated permits shall be reviewed with each worker and be posted at the work site at all time. Review all of the listed sections is required prior to work start.

TABLE OF CONTENTS

INTRODUCTION

This Site Specific Health and Safety Plan provides the methods for dealing with potential hazardous substances and situations associated with the Integrated Technology Demonstration (ITD) of Silo #4. This plan provides an overview of the work and work area, the necessary health and safety training required, and the procedures for dealing with health and safety issues involved with this project. This plan is designed to provide the optimal safety and health protection for persons who are involved with this action. This plan has been developed to adhere to all requirements of OSHA 29 CFR 1910.120 and is written as a supplement to the formal health and safety program at the Feed Materials Production Center.

1.0 TASKS TO BE PERFORMED

The objective of this demonstration is to develop a plan and procedure of robotics technology applications for waste storage tank/silo characterization and future remediation. This ITD will consist of a demonstration using closed circuit television (CCTV) as a visual input device to a computer aided mapping system. This data, recorded in a real-time mode, will produce highly accurate contour maps of the interior of underground storage tanks (UST). Since operations are in a real-time mode, mechanical devices can be operated in conjunction with the video camera. This would allow a task to be performed (i.e. by robotic devices) as a result of observations from a video display.

This unique demonstration will involve Silo 4 at the FMPC. Silo 4 provides relatively ideal testing conditions to demonstrate equipment and procedures with minimal contamination and exposure to hazardous materials. The empty silo is similar in design and structure to many UST facilities in the DOE complex which are currently used to store waste and contaminated materials. A CCTV camera is to be placed within the silo. The camera will have the ability to maneuver within the silo to capture high resolution pictures of the interior structure. The video camera's mobility, maneuverability, operation and picture quality will be tested at this time. These high resolution pictures will then be compiled and transformed into a contour map by means of a computer aided mapping application package.

The successful demonstration of this robotic technology will support removal and remedial activities scheduled for waste storage tanks/silos throughout the DOE complex including sites in Hanford, WA, Idaho Falls, ID, and Fernald, OH. This demonstration will be implemented using CCTV according to approved procedures to map the interior of UST that contain waste material. Real-time feed back will allow an

operator to control the application of a bentonite slurry from a distributor/sprayhead assembly unit. The use of this fill material is strictly to reduce the release of radon gas emissions.

2.0 SITE HISTORY

Silo #4, the test site of this demonstration, is one in a series of four storage tanks within the site management division of Operable Unit 4 at the Feed Materials Production Center (FMPC) in southwestern Ohio. The silos are located in the Waste Storage Area as shown in Figure 2.1. Silos #1 and #2 are referred to as the K-65 Silos due to their storage of K-65 radium-bearing residues resulting from the Manhattan Project. Refinery residues from the processing of high-grade uranium/radium ore are also present within these two silos. Silo #3, to the north of #1 and #2, contains metal oxides from refined slurries. These metal oxides have high concentrations of thorium-230 and other radioisotopes. The northern most silo, Silo #4, has never been used for waste storage and has remained empty since its construction in 1952. Structural analysis indicate the silos have lost more than half their design strength and a life expectancy can not be predicted for the silo domes.

The four waste storage silos 4 are similar in design and structure. The 26' high reinforced concrete walls support a free spanning, 80' diameter dome ceiling. Entry into the silos is limited to five 20" manways; one at the center of the dome, the remaining four in a symmetric pattern concentric to the center manway. Earthen material has been built up around Silos #1 and #2 for additional reinforcement and containment. Silos #3 and #4 are stand alone structures.

3.0 TASK SPECIFIC HAZARD ASSESSMENT

3.1 Hazard Assessment

The evaluation of tasks to be performed during the (ITD) indicates that physical, chemical and radiological hazards may be present. Silo #4 will provide ideal testing grounds for equipment demonstration and procedures while minimizing contamination and exposure concerns. Provisions of this document will institute the best possible safety procedures for the proper protection of all individuals who will have exposure to the hazards associated with this project.

3.2 Physical Hazards

The ITD project will include work activities on the dome of Silo #4. The dome of the silo is contained by a metal hand rail. The east ladder used to access the dome is enclosed with a metal cage. The use of a safety life line while performing work on the silo's dome will be required. This equipment will be made available to all workers and the use of this safety equipment will be done in accordance with the WMCO Industrial Hygiene and Safety Manual, Industrial Hygiene Procedure IH&S-S-14, dated 03/20/89 "Safety Requirements for Working at Elevated Locations".

Special care will be given to trip hazards. This results from the various electrical cords which will be involved in this operation. Electrical cords shall be strung overhead and off the ground in a manner to prevent trip and electrical hazards. Power cords shall not run across walkways. Ground Fault Circuit Interrupters (GFCIs) are to be used for all portable power tools and video equipment.

Standing water within the basin of the silo shall be removed prior to the installation of electrical equipment or power cords into the dome's cavity. This is to be done to prevent a shock hazard to workers.

3.3 Chemical/Radiological Hazards

The waste storage area contains radiounclides of uranium, radium and thorium-230. Thorium-230 is the default radioisotope of concern, because thorium-230 exposure standards are more restrictive and in many cases thorium-230 has the highest activity.

The DOE Oak Ridge Organization skin contamination guideline for Thorium-230 is 300 dpm/100 cm^2. Radiological Regulated Area postings are required at 20 dpm/100 cm^2 removable alpha. Contamination Area postings are required at 200 dpm/100 cm^2 removable alpha.

Radiation levels near Silo #4 are less than 0.5 mrem/hr.

Long-lived airborne radioactivity is not expected to be high in the general area. However, radon and associated short-lived decay products maybe released from K-65 silos in high enough concentrations to be significant at Silo #4. High concentrations are

unlikely except in the case of very stable weather conditions.

Chemical hazards (i.e. lead, mercury, asbestos, etc.) are not expected to be encountered with this remedial action.

4.0 MONITORING

Prior to any task performed in the project area, monitoring will be conducted to determine potential hazards which may be encountered during the course of work.

4.1 Radiological Hazard

Radioactive contamination will be monitored on personnel and equipment leaving the Waste Storage Area and Controlled Area.

Action limits on personnel of 300 dpm/100 cm^2 alpha or 1000 dpm/100 cm^2 beta/gamma will trigger decontamination.

Action limits on material of: 20 dpm/100 cm^2 alpha removable, 100 dpm/100 cm^2 alpha fixed plus removable, 1000 dpm/100 cm^2 beta/gamma removal and 5000 dpm/100 cm^2 fixed plus removable will require decontamination or treatment as radioactive material.

Radon levels will be checked at the installed instruments to the east of the K-65 Silos or near the radon treatment system. An action level of 15 pCi/l radon will trigger analysis of working levels at the work area. An action level of 0.075 working levels will require donning respiratory protection. Full-face air-purifying respirators will be acceptable for up to 15 working levels. Radon levels higher than this will require evacuation from the designated work area.

4.2 Chemical Hazard

Exposure to significant chemical vapor concentrations (flammable vapors, toxic gases, and oxygen deficiencies) are not expected with the tasks associated with this Integrated Technology Demonstration. Exposure to hazardous liquid and solid materials are not expected as well.

4.3 Monitoring for Physical Hazards

Industrial Hygiene shall be contacted for heat stress monitoring when the temperature reaches 80° and readings will be taken at the time to ensure that adequate control measures are taken. Control measures will include plenty of water, rest breaks and careful attention by the supervisor in charge. Also, cool vests will be utilized if necessary. Hearing protection will be provided in the event noise levels exceed 85 decibels.

Hard hats will be worn by the workers to provide protection from overhead hazards.

4.3.1 Collapse of the Dome

To prevent injury or loss of workers on the dome in the event of dome collapse, all workers will remain on the central part of the dome for a limited amount of time. Minimal equipment will be brought on to the dome in order to minimize dome loading. Dome load is not to exceed 700 pounds for personnel and equipment. Work on the silo's dome will be in accordance with Industrial Hygiene and Safety Manual (FMPC-2128), "Safety Procedures for Working at Elevated Locations". A life line and safety harness will be used by all workers who perform work on the dome.

5.0 PERSONAL PROTECTIVE EQUIPMENT

All employees in the task areas will wear the following type of personal protection while performing the required tasks. Specific Personal Protection Equipment required for each specific task will be determined at the time of the FMPC Work Permit is issued. Radiological Engineering will provide default personnel protective equipment (PPE) requirements and action levels which PPE may be worn.

ITEM	NEED	JUSTIFICATION
Air Purifying Respirator	No(Yes)*	Required for work on the silo domes
Cartridges: HEPA	No(Yes)*	Required for airborne radioactivity

Controlled Area Coveralls	Yes	Minimum requirement for work in the restricted area
Safety Glasses	Yes	Minimum requirement, may be satisfied by full-face respirator
Leather-Palm Gloves	No(Yes)*	As needed for physical hand protection of hands and required in Contamination Areas
Hard Hat	Yes	Required for overhead work
Safety Shoes	Yes	Minimum requirements
Shoe Covers	Yes**	Minimum requirements
Safety Harness & Life Line	Yes	Required for work at elevated locations

Note: * The decision in () will be required if safety personnel (fire & safety, radiological technicians, WMCO/RUST safety personnel) determine it to be necessary. These requirements will be determined at the time the FMPC Radiation Work Permit is issued.

** Rubber/Cloth shoe covers are not to be worn on the silo's dome.

Safety equipment shall be provided by the Subcontractor (or WMCO) and be made readily available to all workers at the project site. This will include:

A. Personal protective equipment as specified in Sections 3, 4 and 5.

B. Barricade marking tape

C. Safety signs (as required, i.e. "Hard Hat and Safety Glasses Required", "Personnel Working Overhead", etc.)

D. Radiological monitoring will be performed upon leaving the work area.

E. Fire Extinguishers as deemed appropriate for the situation and the material. A minimum 10 lb. A-B-C fire extinguisher is required in each work area.

6.0 SITE CONTROL

6.1 Access

The work associated with this action will be within the FMPC Radiological area. Although this project is within a radiological area, radiological monitoring has indicated that the work area of Silo #4 is uncontaminated. An Exclusion Zone will not be required unless radiological monitoring determines this to be necessary. Access to the work site (Silo #4 and it's immediate surrounding perimeter) will be controlled at the guard house on the east access road to the waste storage area (Figure 6.1). One access control point will be established for the work site. Personnel will be required to read and sign the Radiation Work Permit (RWP), wear the proper dosimetry, wear the proper protective clothing and wear the proper respiratory equipment. Upon exit of the controlled area, whole-body alpha frisking, vehicle and equipment monitoring will be required.

The Controlled & Radiological Areas of the FMPC are controlled in accordance with the Radiological Controls Manual (FMPC-2084) which provides for:

- the wearing of dosimetry
- radiation safety training
- limitations on entry for personnel with open wounds or recent medical tests with radionuclides
- radiological area postings
- protective clothing
- limitations on food, beverage and tobacco
- general rules of work
- contamination control
- monitoring and showering requirements upon exiting from Controlled and Radiological Areas

Access on to the Silo #4 dome shall be conducted only at the east ladder (Figure 6.1). Other restrictions to access Silo #4 include:

- Full dress in company issued clothing is required for access
- The dome's load limit is not exceed 700 pounds
- Access will not be permitted if the dome's surface is wet or icy
- Rubber/cloth shoe covers are not to be worn

- Contact Don Spahr (6672) prior to dome access

- Life line & Safety harness equipment will be worn in accordance with Industrial Hygiene Procedure IH&S-S-14

6.1.1 Radiological Postings

Radiological areas will be posted in accordance with DOE Order 5480.11.

6.2 Bioassay Samples

Site personnel involved in this project are required to participate in a routine periodic urine assay program.

6.3 Medical Monitoring

In accordance with 29 CFR 1910.120 requirements, all WMCO and WMCO subcontractor personnel are required to participate in a medical monitoring program which includes:

- A baseline medical examination

- Annual medical examination

- Medical examinations may be required after potential exposures.

- WMCO respirator clearance for users

Prior to the start of work, personnel involved in this project shall be identified by name and badge number. Each individual shall be subject to a medical surveillance approval by the Director of Medical Services. The approval statement shall certify that each individual is medically qualified to perform the work and is physically fit to wear PPE.

6.4 Training Requirements

Employees shall not engage in field activities until they have been trained to a level commensurate with their job function, responsibilities and with a degree of anticipated hazards. Due to the nature of this project, subcontractor personnel from Oak Ridge National Labs (ORNL) and Sandia National Labs (SNL) will be participating in this project. All WMCO and WMCO subcontractor personnel assigned to this task will, as a minimum, meet the following training requirements for status of an Occasional Hazardous Site

Worker as prescribed by 29 CFR 1910.120 [(e)(3)(ii)]. These requirements include:

a. Review this Health and Safety Plan for this work including specified hazards and procedures.

b. 29 CFR 1910.120 training (for Occasional Site Workers only; 24-hour program)

c. General Safety

d. Site nuclear criticality training (Criticality Training)

e. Fire Extinguisher

f. You and OSHA

g. Radiation Safety

h. Radiation Safety Personal Monitoring

i. 8-Hour supervised field experience at the FMPC

j. Energy Control Awareness Training

k. K-65 Emergency Response

l. K-65 Operational safety requirements

m. Proof of respirator training and quantitative fit test (Respirator Training) and recent medical examination are required

Escorted visitors will remain under the direct supervision of an FMPC employee that has met all training requirements to access the Process Area. Escorted visitors entering controlled areas require the following training:

a. Visitor orientation videotape

b. Briefing on Site Specific Health and Safety Plan

The completion of required training shall be documented by the site training organization.

6.5 Safety Meetings

A Safety Orientation will be performed for the benefit of the employee by Industrial Hygiene and Safety prior to the start of work. Documented safety meetings

will be conducted prior to the start of each day's work.

These safety meetings will cover the following applicable subjects:

- work operations
- personal protective equipment
- air monitoring data
- hazard communication
- hearing conservation
- monitoring results
- decontamination procedures
- task organization
- physical stress
- emergency procedures
- communications
- general safety
- housekeeping

7.0 DECONTAMINATION

Personnel and equipment decontamination shall be performed in accordance with SP-P-35-017, "Procedure for Personnel Decontamination". Personnel decontamination shall be performed by the standard FMPC exiting shower and clothing change requirement. Equipment found to be contaminated when exiting a radiological area will be taken to the FMPC Decontamination Facility (Figure 7.0).

8.0 EMERGENCY PLANS

The plans shall be consistent with FMPC-2046, "FMPC Emergency Plan".

8.1 Site Evacuation

Should a situation require an emergency evacuation of the site, all equipment shall be turned off and left in place. Personnel shall proceed on foot to Rally Point 6 (Waste Pit Area and Plant 1, see Figure 8.1) and await further instructions.

8.2 Communication

An effective form of two-way communications will be maintained at all times during working hours at the job work site. All workers will be able to call for help and receive information on any site emergency via radio or EMS system. Radio communication will be the preferred form of communication at the work site. Public Address speakers are not present or audible at

a. Site Location of Silo #4 (Figure 2.1)

b. Access to the Controlled Area and Job Work Site (Figure 6.1)

c. Location of FMPC Decontamination Facility (Figure 7.0)

d. FMPC Rally Points (Figure 8.1)

e. Emergency Communications (Figure 8.2)

f. Route to the Nearest Medical Facility from Silo #4 (Figure 8.4)

g. Acknowledgement Log (Figure 11.3)

9.0 Confined Space Entry

A Confined Space Entry Permit will not be required because there will not be any entries into confined spaces during this action. If it is found necessary to enter into the cavity of Silo #4, a Confined Space Entry Permit will be obtained prior to this. Guidelines and requirements of this action will be in accordance with "Control of Entering and/or Working in a Confined Space" (IH&S-IH-05) as listed in the Industrial Hygiene and Safety Manual (FMPC-2128).

10.0 AMENDMENTS

This Site Specific Health and Safety Plan for the Silo #4 Integrated Technology Demonstration is based on information available at the time of preparation. Unexpected conditions may arise which may require reassessment of safety procedures. It is important that personnel protective measures be thoroughly assessed by the supervisor in charge, a WMCO IRS&T representative prior to and during the planned task activities. Changes in the anticipated hazard status or unplanned activities are to be submitted as an amendment to this plan. Amendments must be approved by the plan author, IRS&T, and Industrial Hygiene prior to implementation of the amendment. Field actions and changes which veer from the goals of this safety plan are to be noted and documented.

11.0 GENERAL SAFETY

11.1 Use of the Health & Safety Plan

The Health And Safety Plan is meant to be used as a practical working document for field use at this site. While not specifically mentioned, all OSHA

the work site of Silo #4. The location of emergency telephones and an emergency pull box are shown in Figure 8.2.

8.3 Fire & Explosion Emergency

In the event of a fire and or explosion emergency, the communication center shall be notified immediately by manual fire alarm, two-way radio, or by calling ~~6511~~. The communication center operator will activate the emergency response team and dispatch them to your location. All fires, regardless of size will be reported to WMCO prior to taking action to contain the fire. If a fire is in the incipient stage and perceived controllable without endangering oneself, personnel may use available fire extinguishers. Fire fighting activities are to be conducted with the aid of a stand-by worker. If not in the incipient stage, personnel in the immediate area shall evacuate to a safe position and await further instructions.

8.4 Medical Information

Hospitals

The FMPC Medical Facility (Building 53, Figure 8.4) is the primary choice for on-site injuries. The FMPC ambulance will transport the injured to the nearest hospital facility if necessary. FMPC maintains an emergency response capability which includes and ambulance and Emergency Medical Technicians.

All injuries are to be reported to WMCO.

8.5 Emergency Phone Numbers

The following is a list of emergency contacts and telephone/radio call numbers:

Emergency Response (Fire, Medical)	6511	Control
Communications Control	6295	Control
WMCO Industrial Hygiene	6207	357
WMCO Radiation Safety	6889	355
WMCO Fire and Safety	6235	303
WMCO Medical	6217	
Project Engineer	6896	
Assistant Emergency Duty Officer (AEDO)	6889	202

8.6 Maps and Other Attachments

In addition, the following are attached for reference:

regulations shall be followed during all phases of operation. In addition, any issues which may arise which are not addressed by this document will be covered by the FMPC Site Health and Safety Plan, June 1990.

11.2 Eating, Drinking, and Smoking

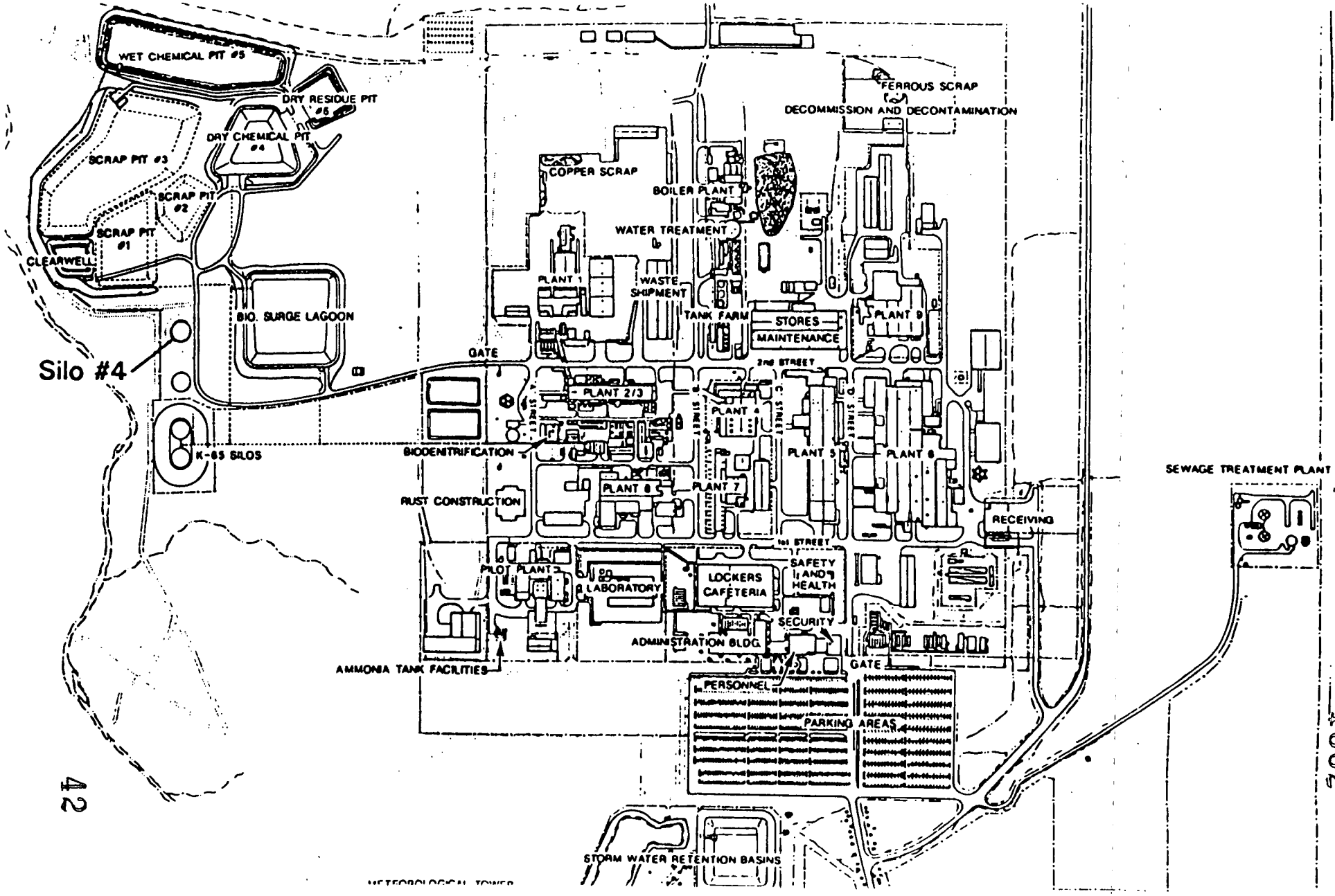
Eating, drinking, smoking and chewing shall be permitted only in designated, posted areas in accordance with the FMPC Site Health and Safety Plan and Radiological Control Manual. There will be no eating or chewing in the Waste Area.

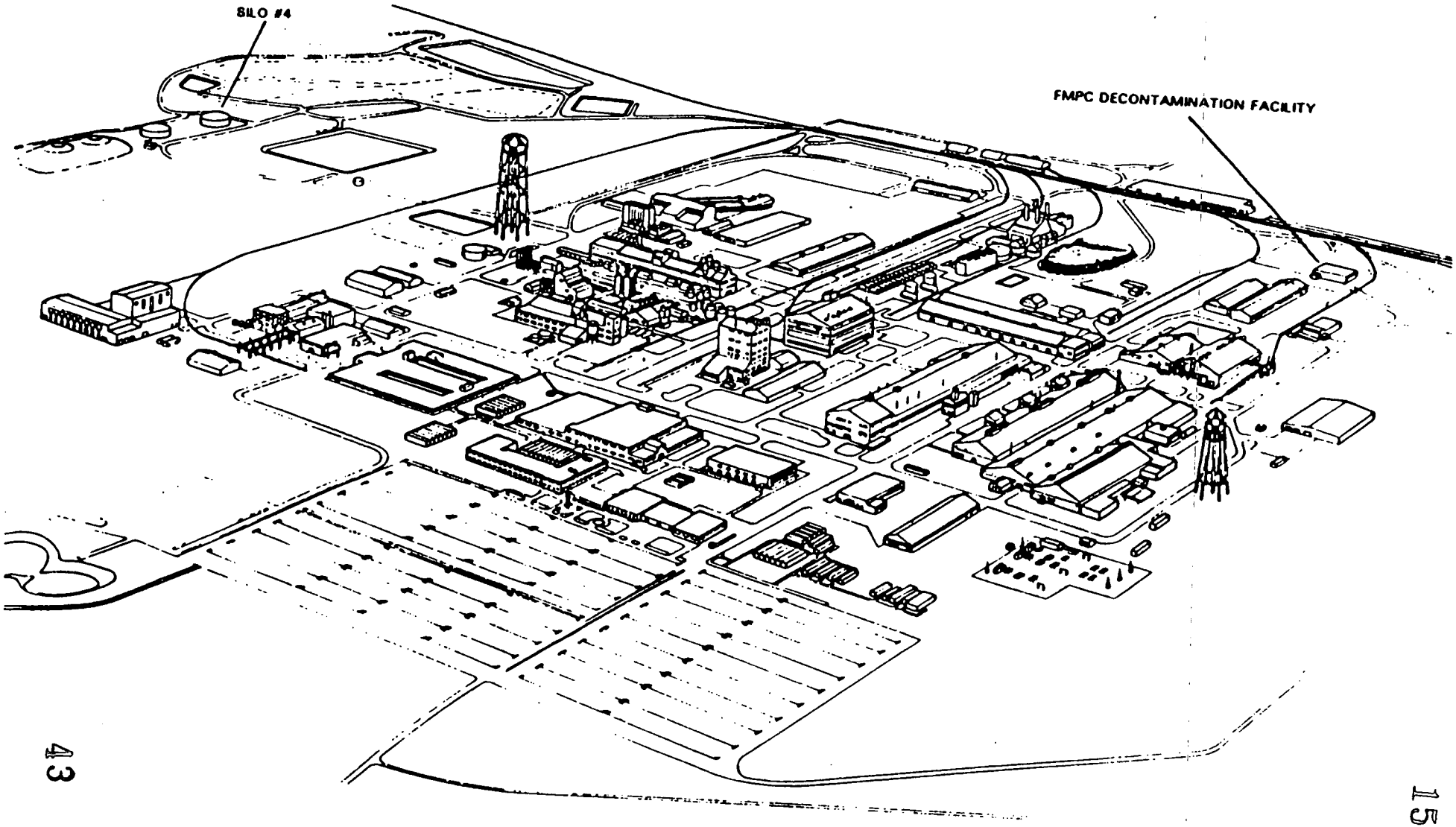
11.3 Review of Health and Safety Plan

Prior to entering the controlled area associated with this project (See Section 6.1) and job site of Silo #4, all persons, both workers and visitors, shall read this Project Specific Health and Safety Plan and sign an Acknowledgement Log (Fig. 11.3) stating they have read and understand the conditions of this plan.

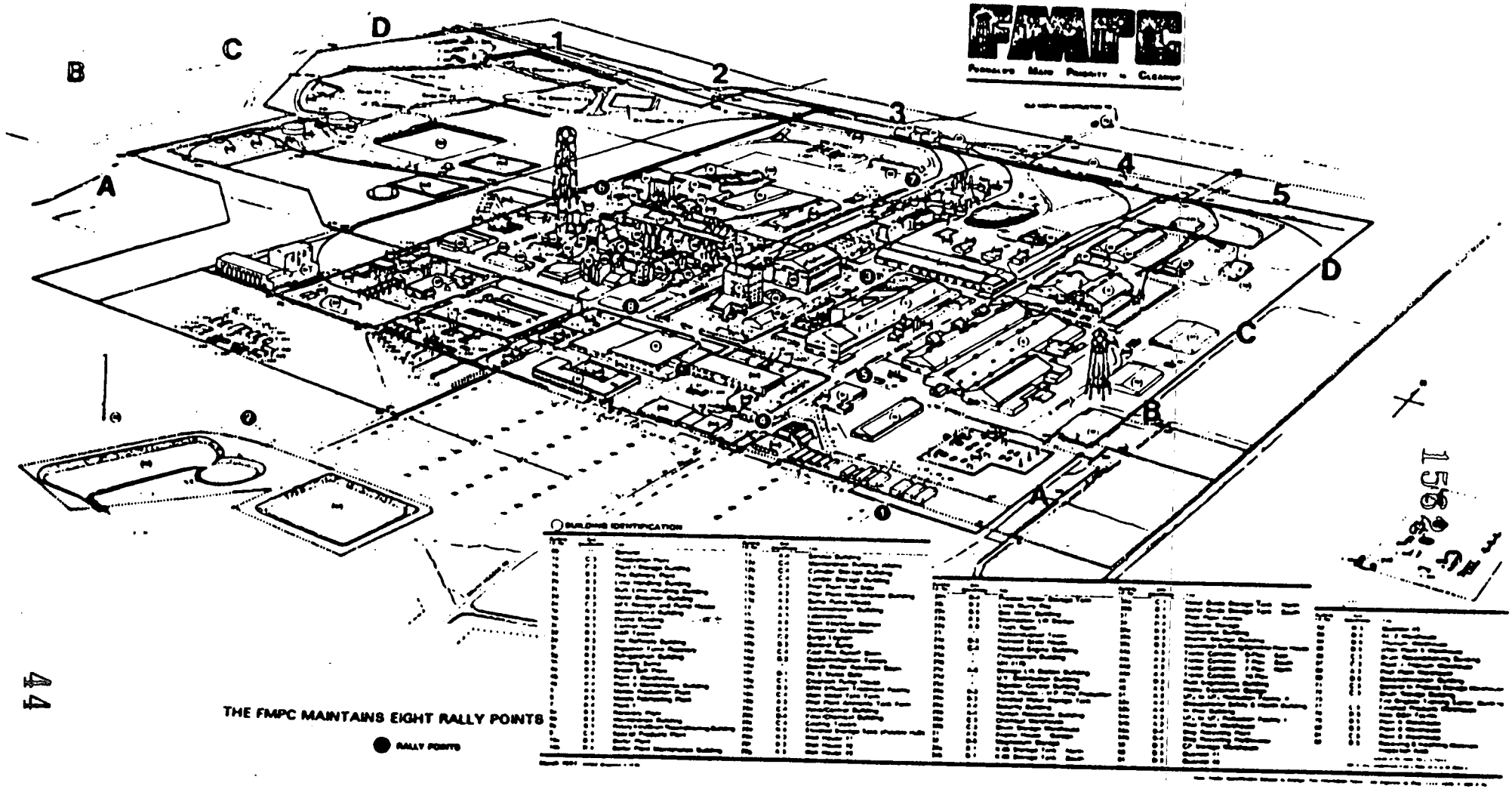
Compliance with the provisions of the Site Specific Health and Safety Plan may be audited through announced or unannounced site visits by DOE or WMCO personnel.

FMPC SITE
(FIGURE 2.1)



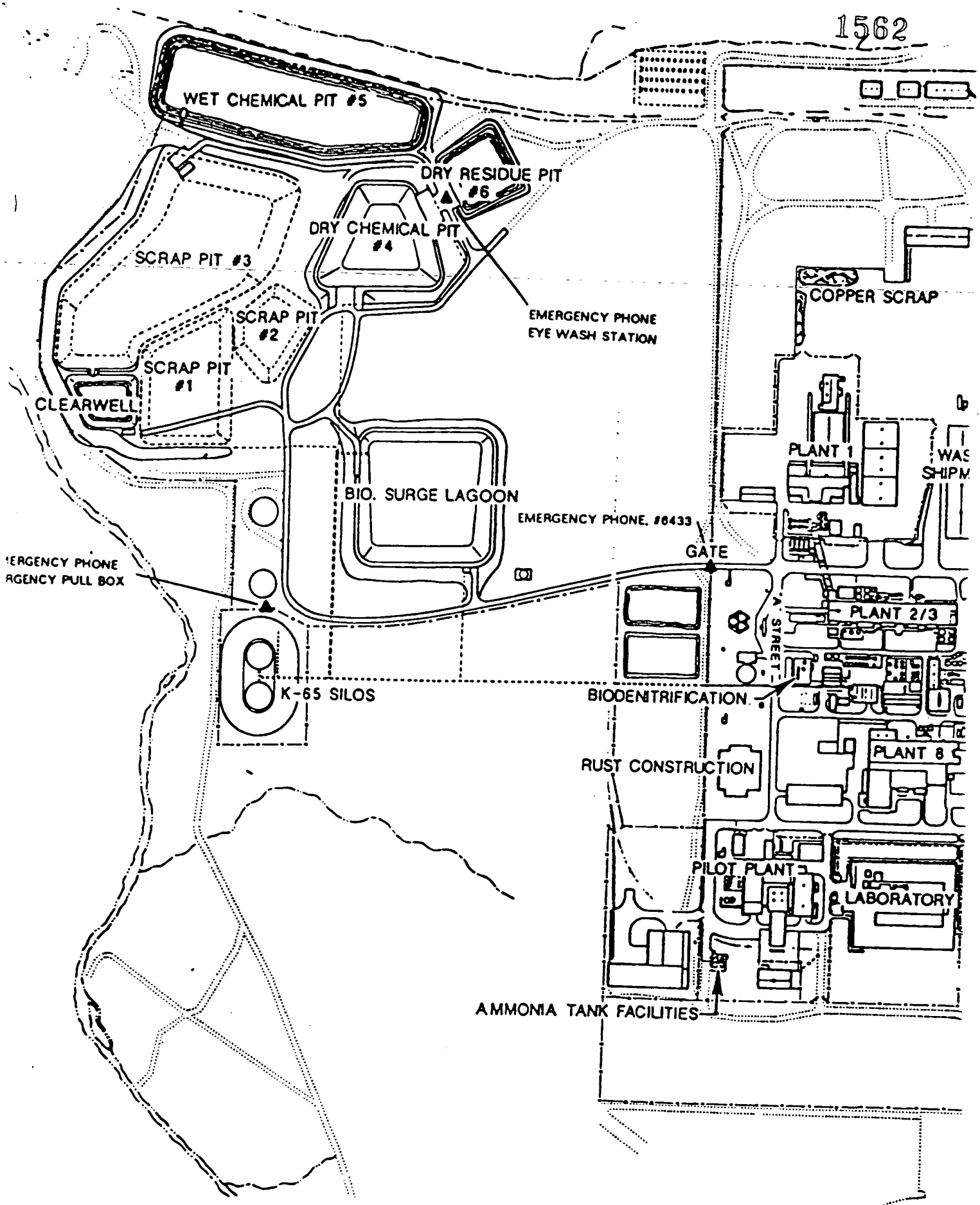


LOCATION OF THE FMPC DECONTAMINATION FACILITY
FIGURE 7.0

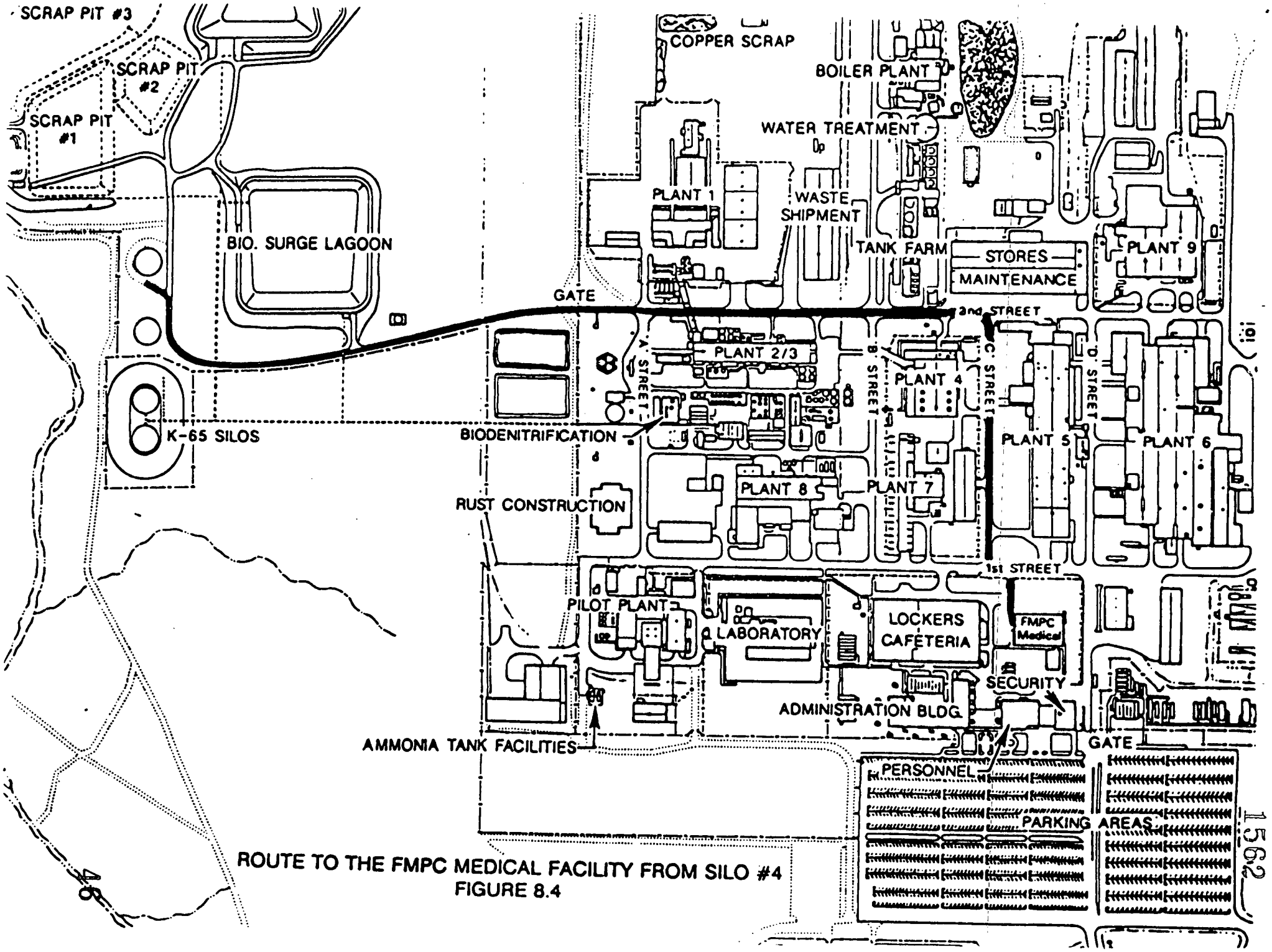


THE FMPC MAINTAINS EIGHT RALLY POINTS

● RALLY POINTS



EMERGENCY COMMUNICATIONS
FIGURE 8.2



ROUTE TO THE FMPC MEDICAL FACILITY FROM SILO #4
FIGURE 8.4

ACKNOWLEDGEMENT LOG

PROJECT SPECIFIC HEALTH AND SAFETY PLAN

FOR THE

SILO #4 INTEGRATED TECHNOLOGY DEMONSTRATION

Signature	Date

FIGURE 11-2

REQUEST FOR SAFETY ASSESSMENT

DATE: 1/17/91

TO: Manager, Nuclear & System Safety

FROM: R. A. Markus

REQUEST THAT A SAFETY ASSESSMENT BE PREPARED FOR THE FOLLOWING PROJECT:

PROJECT TITLE:

Remote Video, Lighting, and Mapping for Remediation of Silos and Tanks

PROJECT NUMBER:	DATE REQUIRED:
00-91301 WBS 1.9.03	3/22/91

PROJECT DESCRIPTION: (PROVIDE A BRIEF DESCRIPTION AND/OR ATTACH DOCUMENTATION DESCRIBING THE PROJECT)

This project consists of a technology demonstration described under the attached Technical Task Plan No.: OR-NEWPG-ROBA-1. The demonstration will be utilizing the Silo #4 structure as a field test bed for the demonstration of state-of-the-art video camera/lighting/surface mapping equipment developed by DOE National Lab Facilities.

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SIGNATURE OF REQUESTER:

FMPC-OS&H-2706 (REV 4/19/88)

1562

REQUEST FOR SAFETY ASSESSMENT

(This section to be filled in by Manager, Nuclear and System Safety)

SAFETY ASSESSMENT IDENTIFICATION NUMBER:

WMCO:IRS&T(NS):91-1007

☐ The request to provide a Safety Assessment by 3/22/91 is accepted, the individual assigned to the project is:

Name: BOB PURCELL Phone No: 6911

☒ An assessment has been performed for the project described in this request and this form will serve as the Safety Assessment document. Based on the information provided with this request for Safety Assessment, no further analysis or documentation is required because this project:

☒ does not introduce or involve hazards not routinely encountered in industry and accepted by the public.

RATIONALE:

[redacted]

This project is to demonstrate and develop remote/robotic video technologies on the empty Operable Unit 4 Silo 4 that will be used to document the removal actions and restorations that will eventually be performed on K-65 Silos 1 & 2 and the Metal Oxide Silo 3 (also in OU4). The remote/robotic video technology may also be used on underground waste storage tanks at the Hanford and Idaho (INEL) DOE sites.

Certain requirements are specified as minimum standards for this video mapping. These standards are the Technical and Programmic Objectives listed as a Criteria for Success. In addition, an alternate technology (ultrasonics) is included in the event of the inability of video technology to meet the criteria for success.

☐ is of a type specifically excluded from requiring a Safety Analysis Report by DOE Letter "Streamlining the Safety Documentation Process" (C. C. Hawkins, 10/9/79).

[redacted]

Since Silo 4 is empty and is only being used as a test bed for this technology, no hazards are being encountered that involve any direct exposure to radioactive or hazardous materials. However, Silo 4 is in the proximity of Silos 1, 2, & 3, and the Waste Pits one thru six. Therefore, certain controls are enforced to gain access to this area, e.g., personnel TLDs, monitoring by Radiation Technicians when leaving the area, etc.

There are no unusual hazards encountered with the execution of this project at Silo 4; however, application of this developed video mapping technology at Silos 1, 2, and 3 will affect the execution of the restoration/remediation projects. The remote video, lighting, and mapping for remediation of those silos will have to be included in the safety assessments for those remediation/removal actions. There is no further need for safety documentation for execution of this project at Silo 4.

SIGNATURE OF MANAGER, NUCLEAR AND SYSTEM SAFETY:	DATE:
J. A. Fitz	3/22/91
[redacted]	
[redacted]:	DATE: 49
SIGNATURE OF [redacted] SECTION MANAGER:	DATE:
K A Solomon	4/2/91